C-A Unreviewed Safety Issue (USI) Form

Title of USI: Change to Critical Devices Listed in BAF SAD

Description of USI (use attachments if necessary): The following replaces Chapter 3, Page 27, Revision 1, 6/15/01 (see highlighted section of attachment 1, former Page 27 BAF SAD). These written changes come about due to changes in critical devices that resulted from a Radiation Safety Committee Review (see attachment 2, Minutes of August 1, 2001 RSC Meeting).

Critical devices are beam-line elements that when placed in a safe state will eliminate the radiation hazard from the beam to safely permit access. As with other aspects of the access controls system, Collider-Accelerator Department requires two completely separate critical devices to be in force before allowing access to any area that can produce greater than 50 rem in one hour from beam. Each of these separate critical devices must mitigate the radiation hazard by itself. Based on a review by the C-AD Radiation Safety Committee (RSC), it was determined that it is impossible to transport any primary beam if the D6 septum is off. The RSC also finds the plug in the front of the BAF tunnel will prevent any transport of any potential secondary beam created on the D6 Septum. Thus, the RSC-approved critical-device is D6 off and the plug in. It is noted that two critical devices are required and are considered adequate by the RSC to disable the extracted Booster Applications Facility beam. Thus, this critical device was engineered such that it is dual and independent. That is, two methods interlock the power supply for D6 and two methods interlock the beam plug position.

The Booster Applications Facility beam line magnets causing the 20^0 bend seen in Figure 3.2.2 are not used as a critical device since there is neither enough shielding nor another bend between these dipole magnets and the Target Room sufficient to mitigate the radiation hazard.

As opposed to disabling critical devices before an authorized entry, unauthorized access through the BGE1 gate or hitting a crash button causes the critical devices to be disabled, which excludes Booster extracted beam to the Booster Applications Facility. Access through BGE2, BGI1 and BGI2 or hitting a crash button in the beam line disables the Booster injected beam from both the Linac and TVDG.

Title and Date of Relevant SAD: Booster Application Facility SAD, 6-15-01

Committee Chair or ESHQ Division Head must initial all items. Leave no blanks:

ITEM	APPLIES	DOES NOT APPLY
Decision to not revise the current SAD and/or ASE at this time: The hazard associated with the proposed work or event is covered within an existing SAD and/or ASE. SAD Title and Date: BAF SAD, 6-15-01. This Form and attachments, if necessary, shall be used to document the USI until the next revision of the appropriate SAD.	ETL ETL	
Decision to submit a revised SAD and/or ASE to the BNL ESH Committee: The hazard associated with the proposed work is not appropriately included in an SAD.		ETL ETL

Ray Karol
Signature of C-A Committee Chair or C-A ESHQ Division Head

4-9-02
Date

Edward T Lessard
Signature of C-A Associate Chair for ESHQ

April 9, 2001
Date

Critical devices are beam-line elements that when placed in a safe state will eliminate the radiation hazard from the beam to safely permit access. As with other aspects of the access controls system, Collider-Accelerator Department requires two completely separate critical devices to be in force before allowing access to any area that can produce greater than 50 rem in one hour from beam. Each of these separate critical devices must mitigate the radiation hazard by itself. The D6 Septum, D3 Septum and D6 Extraction Bumps are the critical devices located in the Booster ring used to prevent beam extraction and allow access to the Booster Applications Facility beam line. See Figure 2, Appendix 5. The D3 septum itself is not efficient in preventing extraction. The D3 septum is combined with the bump power supplies as one critical device; the thick septum at D6 would be the other. Modeling shows that each of these two devices prevent primary beam from being extracted. There will still be the need to close the BAF beam plug for any access. It is noted that two critical devices are required and are considered adequate by the C-A Radiation Safety Committee to disable the extracted Booster Applications Facility beam. The Booster Applications Facility beam line magnets causing the 20^{o} bend seen in Figure 3.2.2 are not used as a critical device since there is neither enough shielding nor another bend between these dipole magnets and the Target Room sufficient to mitigate the radiation hazard.

As opposed to disabling critical devices before an authorized entry, unauthorized access through BGE1, BGE2 and BGI1 gates or hitting a crash button causes the critical devices to be disabled, which excludes Booster extracted beam to the Booster Applications Facility. Access through BGI2 disables the Booster injected beam from both the Linac and TVDG.

Before permitting beam into any beam line, the MCR Operations group must ensure that the beam line enclosure is cleared of personnel. This is accomplished by a search of the area followed by an area reset. In order to make further entries and retain the swept state, the system is placed in the Controlled Access state. In the Controlled Access state, the entrants must obtain a key from the key tree. Under observation by MCR operators, entrants insert the key into the gate switch and receive a simultaneous gate release from the Main Control Room. Possession of the key by the entrant prevents a change from a safe state to the beam enabled state.

In order to limit the effort needed for clearing personnel from the affected area, the Booster Applications Facility beam enclosure is divided into three sweep zones. Each zone is instrumented with reset stations appropriately located to focus attention during the sweep in locations of limited line-of-sight.

There are two gate position-sense switches mounted at each gate. These switches give a positive indication that the gate is in the closed position. Each gate has one electric strike. In Controlled Access state, the electric strike must be energized from the MCR in order to access the area. All gates provide a means of emergency egress. The emergency-crash-glass on gates, which is used to permit emergency access to the area, is monitored and will interlock the beam if not intact.

The Restricted Access state applies to all Booster Applications Facility enclosure gates and does not require a key from the key tree for access. Entrants are issued a special key for access and beam is disabled by operations staff using the critical devices. On the other hand, Controlled Access entry requires a key from the key tree and a simultaneous gate release from MCR for access and egress. In this state, control and

Attachment 2

C-AD
Radiation Safety Committee

Issued: September 12, 2001

Minutes of Radiation Safety Committee of August 1, 2001

BAF Critical Devices

Present: L. Ahrens, D. Beavis, I.-H. Chiang, E. Lessard, W. MacKay, R. Prigl, A. Steven sand N. Williams

The critical devices for BAF were reviewed. A description by R. Prigl and K. Brown was previously distributed to the committee (see file attachment 1). Beam studies have shown that it is possible to scrap the D6 septum with the bumps and thin septum off. Such scrapping can create a secondary beam for the BAF transport and therefore renders these devices as not acceptable as critical devices for BAF. It is impossible to transport any primary beam if the D6 septum is off. The plug in the front of the BASF tunnel will prevent any transport of any potential secondary beam created on the D6 septum. The approved critical device (or state) is D6 off and the plug in. This state must be defined dual and independent. The CEE will approve the method to interlock the Power supply for D6 **(Ck-BAF-fy2002-252)** . The CME will approve the interlocks on the beam plug **(Ck-BAF-FY2002-253)** .

The review of the interlocks must take into account the closing time for the beam plug. This review will occur after the plug is tested for opening and closing times. **(Ck-BAF-FY2002-254)**

The interlocks will require that the plug be removed before the D6 septum can be turned on. **(Ck-BAF-FY2002-255)**

The reachbacks for these devices will be Booster Injection. **(CK-BAF-FY2002-256)**

As noted in a previous meeting there will be two chipmunks located after the beam plug. Fault studies will need to be conducted to determine if access can be allowed to the zone near the dipoles. Attention must be given to the dose that can be obtained in a fault if personnel are allowed to access this area with the booster beam on.

The new location of the booster beam dumps needs to be reviewed for both soil activation and secondary radiation. **(CK-BAF-FY2002-257)**

Documentation showing that D6 off prevents all primary beam from entering the BAF apeture must be sent to the RSC Chairman for the files. **(CK-BAF-FY2002_258)**

Attachments (file copy)
K. Brown and R. Prigl, Memo of July 27, 2001.

CC:
BAF File
Minutes File

Attachment 2

date: *July 27, 2001*

to: *RSC*

from: *K. Brown, R. Prigl*

subject: ***Review of BAF critical devices.***

Slow extraction of beam into the Booster Application Facility (BAF) is achieved using the following devices:

(1) A thin septum located at straight sectionD3.
(2) A thick septum at straight section D6.
(3) Four lattice sextupoles used to drive a resonance.
(4) Slow orbit bumps centered at the locations of the two septum magnets.

After exiting through the thick septum, the beam is transported along a roughly 300 ft long beam line to the BAF target room. Since the beam line includes only a single 20-degree bend, only the extraction devices listed above are being considered as critical devices for the BAF facility, apart from the Booster critical devices. The sextupoles, which drive the resonant extraction, are not dedicated to BAF operation, narrowing the selection to the two septum magnets and the dedicated orbit bumps. The BAF-CDR (Oct. 1997) stated that any of these three "devices" would likely be adequate to prevent beam extraction into the BAF beam line. However, in subsequent discussions we concluded that neither the bumps nor the thin septum alone would provide sufficient protection, but that the combination of the two could be a credible critical device. Recently K. Brown has started looking at this issue in detail and found modes of operating the Booster where there could be a chance of getting a small fraction of the beam circulating in the Booster past the 15.2 mm thick septum with the BAF extraction bumps and the thin septum off. In this case, the only credible critical element, other than preventing beam in the Booster, would be the thick septum at D6, and we are considering adding a reversing switch to the power supply, or an interlock to the AC disconnect switch, to serve as an independent device.

Fault conditions with the thick septum off have been studied by A. Stevens and R. Prigl and were presented to the RSC in meetings on 6-22-99 and 4-13-00. During Booster operation, the steel plug upstream of the 20-degree bend has to be inserted in order to access the downstream BAF beam line. With the 20-degree bend off, the section after the bend can be treated as a one-leg labyrinth and provides a reduction factor of about 7000 compared to levels near the bend. In general we have to assume that the bend is on and that it's rigidity is lower than that of the beam in the Booster because of the higher charge state of the ions in the beam line in a typical BAF heavy ion mode. Therefore even for access to the target room the beam plug needs to be inserted to prevent the transport of a secondary charged beam down the line.

Although the studies are not completed, we would like to present our present understanding concerning the BAF critical devices to the RSC for review.